

Lesson 9

Evaluating Public Health Surveillance

Instructor's Guide Form

Lesson Title: Evaluating public health surveillance

Lesson Goal: For each learner to be able to apply the elements of evaluation to surveillance systems

Learning Objectives: By the end of this lesson, the learner will be able to:

- 1) describe the types of evaluation used in public health surveillance
- 2) differentiate among the aspects of the evaluation of surveillance systems:
 - public health importance
 - objectives and usefulness
 - operation of the system
 - qualitative attributes
 - quantitative attributes
 - predictive value positive
 - cost
- 3) outline the components of a report for the evaluation of a surveillance system

Equipment and materials:

- Overhead projector
- Transparencies #9.1 - #9.19

Time Required: 90 minutes

Lesson 9

Evaluating Public Health Surveillance

Instructor's Guide Form (continued)

Synopsis of Lesson: This lesson provides learners with information needed to evaluate a public health surveillance system.

Adult Education Application: This chapter contains numerous synthesizing concepts that require learners to integrate several levels of information in order to be able to evaluate a surveillance system. As in previous chapters, several of the ideas require the use of arithmetic principles. Most notably, predictive value positive (PVP) uses arithmetic relationships to calculate a value. Learners who do not need to calculate the value will need examples of how PVP is an important concept. For the more advanced learners, opportunities to do the calculations will be needed. In either case, the learners could be engaged in a summary exercise that asks them to devise an ideal surveillance system for a particular condition or disease. They could do this in small groups or as an entire class activity. The instructor could also develop a problem that requires students to work in groups developing an evaluation scheme for a surveillance program.

Lesson 9

Evaluating Public Health Surveillance

Topical Outline

- I. Types of evaluation**
 - A. Level one evaluation
 - B. Level two evaluation
- II. Adapting the evaluation**
 - A. Approach to evaluation
 - B. Elements of surveillance evaluation
- III. Public health importance**
 - A. Influences on determining public health importance of a health event
 - B. Measures of importance of a health event
 - C. Political and public pressure
 - D. Attempts to quantify public health importance
- IV. System objectives and usefulness**
 - A. Define the health event under surveillance
 - B. Give the explicit objectives of the system
 - C. Impact of the surveillance system on health event occurrence
 - D. Usefulness
- V. Operation of the system**
 - A. Aspects of operation to be described
 - B. Questions for evaluation of system operation
- VI. Qualitative attributes**
 - A. Types of qualitative attributes
 - B. Simplicity of a surveillance system
 - C. Flexibility of a surveillance system
 - D. Acceptability of a surveillance system

Lesson 9

Evaluating Public Health Surveillance

Topical Outline (continued)

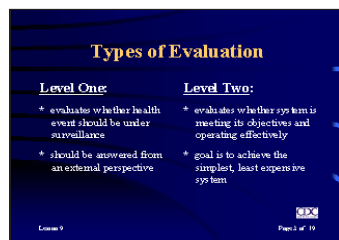
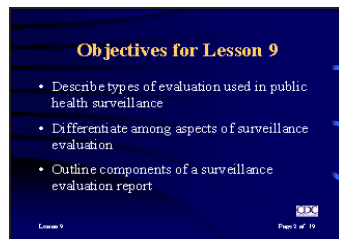
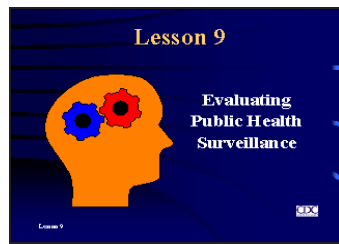
VII. Quantitative attributes

- A. Types of quantitative attributes
- B. Measurement of quantitative attributes
- C. Sensitivity of a surveillance system
- D. Predictive value positive
- E. Representativeness of surveillance system.
- F. Timeliness of surveillance.

VIII. Cost

- A. Definition: cost is an estimation of the resources used to operate the system
- B. Direct personnel and resource costs
- C. Indirect costs
- D. Costs are judged relative to benefits
- E. The cost-benefits related to reducing the number of cases of a disease can also be calculated looking at both direct and indirect costs
- F. Example of costs of surveillance

IX. Outline of sample surveillance evaluation report



Lesson 9

Evaluating Public Health Surveillance

Content Outline

Lesson Objectives:

- Describe the types of evaluation used in public health surveillance
- Differentiate among the elements of surveillance evaluation:
 - ◆ public health importance
 - ◆ objectives and usefulness
 - ◆ operation of the system
 - ◆ qualitative attributes
 - ◆ quantitative attributes
 - ◆ cost
- Outline the components of a surveillance evaluation report

I. Types of evaluation

A. Level one evaluation

1. asks the question: "Should this health event be under surveillance?"
2. is primarily an assessment of the public health importance of a health event and how its importance compares with that of other health events
3. should be answered from a perspective external to the surveillance system itself
4. should be asked when deciding whether to start a new system or before conducting a detailed evaluation of an existing one

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B. Level two evaluation

1. evaluates an operating surveillance system for a high-priority health event to potentially increase the system's utility and efficiency
2. may compare two or more systems involving the same health event
3. should determine whether the system is meeting its objectives, serving a useful public health function, and operating as efficiently as possible
4. steps in this type of evaluation
 - a. state an explicit statement of the purposes and objectives of the system
 - b. describe its operation
 - c. document how the surveillance system has been useful
 - d. assess the different quantitative and qualitative attributes
 - e. estimate the cost of the system
5. goal of evaluation
 - a. to maximize the system's usefulness
 - b. to achieve the simplest, least expensive system that meets the objectives

II. Adapting the evaluation

A. Approach to evaluation

1. success of an individual surveillance system depends on the proper balance of characteristics
2. strength of an evaluation depends on the ability of the evaluator to assess these characteristics with respect to the system's objectives



3. the approach must be flexible
4. evaluations must be individually developed

B. Elements of surveillance evaluation

1. public health importance
2. objectives and usefulness
3. operation of the system
4. qualitative attributes
 - a. simplicity
 - b. flexibility
 - c. acceptability
5. quantitative attributes
 - a. sensitivity
 - b. predictive value positive
 - c. representativeness
 - d. timeliness
6. cost

III. Public health importance

A. Influences on determining public health importance of a health event

1. health events that affect many people or require large expenditures of resources are important in a public health context (i.e. hepatitis B)

2. health events that affect relatively few persons may also be important, especially if the events cluster in time and place (i.e., a limited outbreak of a severe disease, e.g. plague, or a new disease)
3. public concerns may focus attention on a particular health event, creating or heightening the sense of importance associated with it (e.g. toxic shock syndrome)
4. health problems that are now rare because of successful control measures may be perceived as unimportant, but their level of importance should be assessed on the basis of their potential to reemerge (e.g. diphtheria)
5. preventability and the ability of public health action to influence it (e.g. measles)

B. Measures of importance of health event



1. magnitude of the problem; ways to monitor
 - a. total number of cases
 - b. incidence
 - c. prevalence
2. morbidity; ways to monitor
 - a. physician visits
 - b. hospital days
3. severity; ways to monitor
 - a. mortality rate
 - b. case-fatality ratio
4. premature mortality; way to monitor
 - a. years of potential life lost (YPLL)
5. economic cost

- a. ways to monitor
 - 1) costs of medical care
 - 2) lost productivity

6. preventability

- a. monitored by prevented fraction
- b. defined at several levels
 - 1) primary prevention (preventing the occurrence of disease)
 - 2) secondary prevention (early detection and treatment)
 - 3) tertiary prevention (minimizing the effects of the health problem among those already ill)

C. Political and public pressure

- 1. may affect whether surveillance is undertaken or forbidden
- 2. important to make scientific criteria as clear and explicit as possible

D. Attempts to quantify public health importance

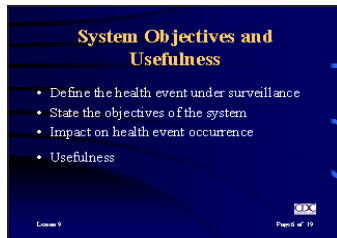
- 1. Dean's approach
 - a. calculated a score that:
 - b. accommodated for age-specific mortality and morbidity rates and health-care costs
- 2. Canadian Laboratory Centre for Disease Control
 - a. used explicit criteria in setting national surveillance priorities for communicable diseases

- b. criteria
 - 1) potential for outbreaks
 - 2) public perception of risk
 - 3) necessity for immediate public health response
 - 4) magnitude
 - 5) severity
 - 6) morbidity
 - 7) premature mortality
 - 8) economic cost
 - 9) preventability
- c. their ratings for 60 communicable diseases were useful in setting priorities for initiating a surveillance system

IV. System objectives and usefulness

A. Define the health event under surveillance

1. develop a case definition that includes
 - a. clinical description
 - 1) signs
 - 2) symptoms
 - b. laboratory, if appropriate
 - c. epidemiological criteria
 - 1) time
 - 2) place
 - 3) person
 - d. categories in the diagnosis
 - 1) confirmed
 - 2) probable
 - 3) suspected



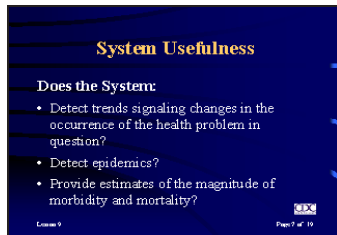
- B. State explicitly the objectives of the system**
- C. Impact of the surveillance system on health event occurrence**

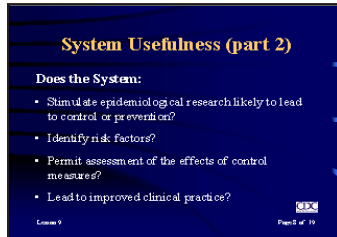
1. reduce impact on population
 - a. morbidity
 - b. severity
 - c. mortality
 - d. cost
2. satisfy political or public concern
3. meet World Health Organization requirements

D. Usefulness

1. components of usefulness
 - a. actions that have been taken as a result of the data and analysis from the surveillance system
 - b. who used the data to make decisions and take actions
2. assessment of usefulness of a surveillance system
 - a. consider the dependence of policy decisions and control and prevention measures on the surveillance system
 - b. may be useful if determines a health event that once was important and is no longer important
 - c. questions concerning usefulness to be addressed during assessment

- 1) does the system detect trends signaling changes in the occurrence of the health problem in question?
- 2) does the system detect epidemics?





- 3) does the system provide estimates of the magnitude of morbidity and mortality related to the health problem being monitored?
- 4) does the system stimulate epidemiologic research likely to lead to control or prevention?
- 5) does the system identify risk factors involved in the occurrence of the health problem?
- 6) does the system permit assessment of the effects of control measures?
- 7) does the system lead to improved clinical practice by the health-care providers who are the constituents of the surveillance system?

d. attributes of surveillance which can affect usefulness

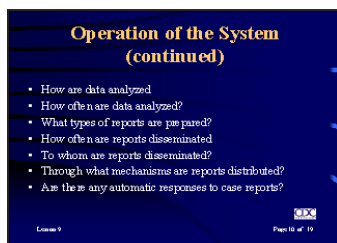
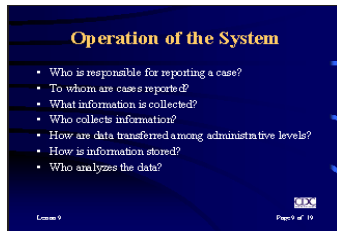
- 1) increased sensitivity may afford a greater opportunity for identifying epidemics and understanding the natural course of an adverse health event in a community
- 2) more rapid reporting allows more timely control and prevention activities
- 3) increased specificity enables public health officials to focus on productive activities

V. Operation of the system

A. Aspects of operation to be described

1. the people and organizations involved
2. the flow of information (up and down)
3. mechanisms of information transfer

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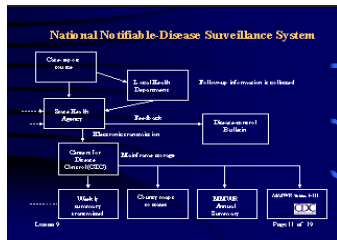


4. frequency of reporting and feedback
5. quality control

B. Questions for evaluation of the system operation

1. who is the population being monitored?
2. who is responsible for reporting a case, and to which public health agency?
3. what information is collected on each case, and who is responsible for collecting it?
4. if there are multiple administrative levels represented in the system, how are the data transferred from one level to another?
5. how is information stored?
6. who analyzes the data?
7. how are they analyzed, and how often?
8. are there preliminary and final tabulations, analyses, and reports?
9. how often and to whom are reports disseminated?
10. by what mechanisms or media are the reports distributed?
11. are there any automatic responses to case reports (e.g., follow-up of individual cases of rabies, or botulism)

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12. a chart may be useful to summarize the relationship between various components

VI. Qualitative attributes

A. Types of qualitative attributes

1. simplicity
2. flexibility
3. acceptability

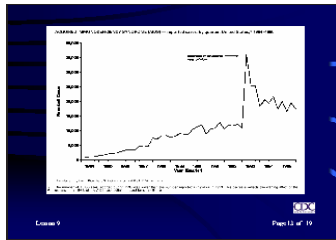
B. Simplicity of a surveillance system

1. simplicity refers to structure and ease of operation of system
2. surveillance system should be as simple as possible, while still meeting objectives
3. two perspectives regarding the simplicity of a system
 - a. design of the system
 - b. size of the system
4. following measures may be used in evaluating simplicity of a system
 - a. amount and type of information necessary to establish a diagnosis
 - b. number and type of reporting sources
 - c. methods of transmitting case information and data
 - d. staff training requirements
 - e. type and extent of data analysis
 - f. amount of computerization
 - g. methods of distributing reports
 - h. amount of time spent operating the system

C. Flexibility of a surveillance system

1. refers to the ability of the system to adapt to changing needs (e.g. changes in age of measles cases)

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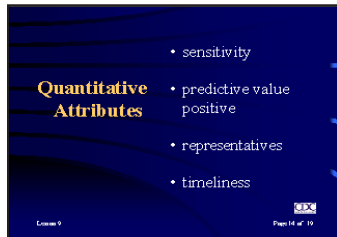


2. can the system adapt to change in the objectives? (e.g. monitor disease in new migrants)
3. can the system adapt to the addition of new conditions? (e.g. a new vaccine introduced into population like acellular pertussis vaccine)
4. can the system adapt to a change in the data-collection elements?
5. can the system adapt to a change in the case definition? (e.g. AIDS)
6. can the system adapt to a change in resources? (e.g. reduced budget)

D. Acceptability of a surveillance system

1. questions to consider regarding acceptability
 - a. are individuals and organizations willing to participate in the surveillance system?
 - b. is the system acceptable to health department staff?
 - c. is the system acceptable to health professionals who are asked to report cases
 - 1) is case definition acceptable?
 - 2) is the reporting mechanism acceptable?
2. assessing acceptability
 - a. consider the points of interaction between the system and its participants
 - b. indicators of acceptability
 - 1) subject or agency participation rates
 - 2) interview completion rates and question refusal rates, if the system involves case interviews

- 3) completeness of report forms
- 4) physician, laboratory, hospital or facility reporting rates
- 5) timeliness of reporting



VII. Quantitative attributes

A. Types of quantitative attributes

1. sensitivity
2. predictive value positive
3. representativeness
4. timeliness

B. Measurement of quantitative attributes

1. are often difficult to measure precisely
2. indirect estimates can be useful in helping to improve efficiency of a system and in comparing it with other systems

C. Sensitivity of a surveillance system

1. ways to consider sensitivity
 - a. consider the completeness of case reporting; proportion of cases of the disease detected by surveillance system ($A/A+C$)
 - b. consider the ability of system to detect epidemics

The Detection of Health Conditions with a Surveillance System

		Condition Present		
		Yes	No	
Detected by Surveillance	Yes	True Positive A	False Positive B	A + B
	No	False Negative C	True Negative D	C + D
		A + C	B + D	

Lesson 9 "Sensitivity" = A/(A+C) Page 15 of 19

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2. factors affecting the sensitivity of a surveillance system
 - a. likelihood that persons with the health condition seek medical care
 - b. likelihood that the condition is correctly diagnosed, which reflects the skill of health care providers and the accuracy of diagnostic tests
 - c. likelihood that the case is reported to the system, once it has been diagnosed (passive surveillance)
3. measurement of sensitivity
 - a. requires the validation of information collected through the system to distinguish accurate from inaccurate case reports
 - b. requires collection of information external to the system to determine the real frequency of the condition in a community (i.e. gold standard)
 - c. completeness of coverage
 - 1) primary emphasis, assuming that most reported cases are correctly classified, is estimating what proportion of the total number of cases in the community are being detected by the system
 - 2) if proportion is estimated using methods that compare two or more surveillance systems, none of which is a “gold standard”, then proportion is an estimate of completeness of coverage
 - d. can evaluate sensitivity using active surveillance to check on passive surveillance
4. factors affecting changes in sensitivity
 - a. heightened awareness of a health problem
 - b. introduction of new diagnostic tests
 - c. changes in the method of conducting surveillance

5. a surveillance system without high sensitivity can still provide useful trend data if sensitivity and predictive value positive remain reasonably constant

D. Predictive value positive

1. predictive value positive (PVP) is the proportion of persons reported as case-patients who actually have the condition being monitored ($A/A+B$)
2. in assessment of PVP, primary emphasis is placed on the confirmation of cases reported through the surveillance system
3. effect of PVP at level of an individual case
 - a. PVP affects the amount of resources required for investigation of cases
 - b. example
 - 1) where every reported case of hepatitis A is promptly investigated
 - 2) family members at risk are referred for prophylactic immune globulin
 - 3) each reported case generates a requirement for follow-up
 - 4) a surveillance system with a low PVP, and therefore frequent false-positive case reports, would lead to resources being wasted on cases that do not exist
4. effect of PVP at level of epidemics
 - a. a high rate of erroneous case reports over the short term might trigger an inappropriate epidemic investigation

The Detection of Health Conditions with a Surveillance System

		Condition Present		
		Yes	No	
Detected by Surveillance	Yes	True Positive A	False Positive B	A + B
	No	False Negative C	True Negative D	C + D
1. Sensitivity = $A/(A+C)$ 2. Predictive Value Positive = $A/(A+B)$		A + C	B + D	Total

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- b. conversely, a constant high level of false-positive reports might mask a true epidemic
 - c. investigator needs to know what proportion of epidemics identified by the surveillance system are true epidemics
- 5. meaning of a low PVP
 - a. non-cases are being investigated
 - b. there may be mistaken reports of epidemics
 - c. false-positive reports to surveillance systems lead to unnecessary interventions, and falsely detected “epidemics” lead to costly investigations
- 6. ways to enhance PVP for a health event
 - a. use of clear and specific case definitions
 - b. use of good communication between the persons who report cases and the staff operating the surveillance system
 - c. PVP increases with increasing specificity and prevalence

E. Representativeness of surveillance system

- 1. a representative surveillance system accurately describes the occurrence of a health event over time and its distribution in the population by place and person and reflects its actual occurrence
- 2. assessment of representativeness
 - a. compare the characteristics of reported events with those of all such events that occurred
 - b. factors to use in assessment of representativeness
 - 1) characteristics of the population
 - a) age
 - b) socioeconomic status
 - c) geographic location

- 2) natural history of the condition
 - a) latency period
 - b) fatal outcome
- 3) multiple sources of data
 - a) mortality rates for comparison with data on incidence
 - b) laboratory reports for comparison with physician reports

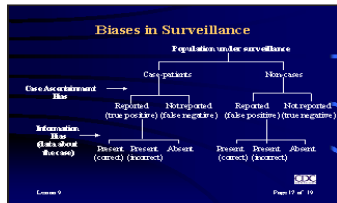
4. types of bias which can enter a surveillance system and decrease representativeness

a. case ascertainment bias (or sampling bias)

- 1) the differential identification and reporting of cases from different populations over time
- 2) factors influencing bias
 - a) changes in reporting practices over time
 - b) publicity
 - c) differences in reporting practices by geographic location
 - d) different characteristics of the person, so that cases among certain subpopulations may be less likely to be reported than those among other groups

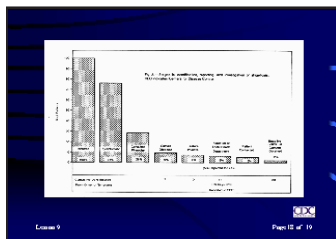
b. bias in description information about a reported case

- 1) information bias are errors in the collection and recording of description information about the case
- 2) errors and bias can make their way into a surveillance system at any stage in the reporting and assessment process



F. Timeliness of surveillance system

1. timeliness reflects the delay between any two (or more) steps in a surveillance system
2. timeliness can be assessed by the ability of the system to take appropriate action, within a period of time, based on the urgency of the problem and the nature of the public health response
3. points in time in the surveillance process which are considered when measuring timeliness
 - a. time of onset of disease or occurrence of an injury
 - b. time of diagnosis
 - c. time of receipt of the report of case by public health agency responsible for control activities
 - d. time of implementation of control activities
4. measurement of timeliness
 - a. usually measured in days or weeks
 - b. in hospital settings timeliness may be measured in hours
 - c. for diseases that do not necessitate an immediate response, timeliness may be measured in months or years
5. studies of timeliness
 - a. shigellosis study
 - 1) found median delays of 11 and 12.5 days from time of onset of illness to receipt of report by the public health agency responsible for control measures
 - 2) delay did not allow public health officials to intervene in a timely manner to prevent the occurrence of secondary or tertiary cases



- 3) such a time frame might still allow for effective intervention in settings, such as day-care facilities, in which outbreaks may persist for weeks or months

VIII. Cost

A. Definition: cost is an estimation of the resources used to operate the system

1. estimates are generally limited to direct costs
2. estimates include the costs of personnel and resources required for collecting, processing, and analyzing surveillance data, as well as for the dissemination of information resulting from the system

B. Direct personnel and resources costs

1. may be determined from an estimate of the time it takes personnel to operate the system
2. this can be expressed as person-time expended per year of operation
3. is preferable to convert estimate to dollar costs by multiplying the person-time by appropriate salary and benefit figures
4. other costs
 - a. travel
 - b. training
 - c. supplies
 - d. equipment
 - e. services such as mail, telephone, rent, and computer time

C. Indirect costs

1. follow-up laboratory testing or treatment
2. case investigations or epidemic control resulting from surveillance
3. costs of secondary data sources (e.g., vital statistics or survey data)

D. Costs are judged relative to benefits

1. estimate of costs averted (benefits) by surveillance
2. few evaluations of surveillance systems have included a formal cost-benefit analysis
3. costs should be judged with respect to the objectives and usefulness of a specific surveillance system

E. The cost-benefits related to reducing the number of cases of a disease can also be calculated looking at both direct and indirect costs

F. Example of costs of surveillance

1. in Vermont, two methods of collecting surveillance data were compared
2. the passive system was already in place and comprised passive reports of notifiable diseases to the district offices or the state health department
3. the active system was implemented to involve in a probability sample of physicians' practices
4. each week a health department employee called these practices to solicit reports of selected notifiable diseases

Comparison of Estimated Costs for Active and Passive Surveillance Systems in a Health Department, Vermont, June 1, 1980, to May 31, 1981

	Type of Surveillance System	
	Active*	Passive**
Paper	\$ 114	\$ 80
Mailing	185	48
Telephone	1,247	175
Personnel		
Secretary	3,000	2,000
Public health nurse	14,025	0
TOTAL	19,271	2,203

*Active - Weekly calls to 100 randomly selected physicians to report notifiable diseases.
**Passive - Passive surveillance system.
Source: Vermont Health Department, 1981.
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IX. Outline of sample surveillance evaluation report

1. handout of Table 8-4 from text, page 172
(*see page 180*)
2. discuss report components